इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 9785 (1981): Code of safety for aluminium alkyls [CHD 8: Occupational Safety, Health and Chemical Hazards]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

COMPLIMENTARY

IS : 9785 - 1981
(Reaffirmed 2003)

Indian Standard
CODE OF SAFETY FOR ALUMINIUM ALKYLS

UDC 614·878 : 547·256·2-024

© Copyright 1981

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

[redacted] Gr 3

August 1981

Indian Standard

CODE OF SAFETY FOR ALUMINIUM ALKYLS

Chemical Hazards Sectional Committee, CDC 18

Chairman	*Representing*
Shri S. C. Kale	Directorate General, Factory Advice Services & Labour Institutes (Ministry of Labour), Bombay
Members	
Dr V. P. Gupta (*Alternate* to Shri S. C. Kale)	
Shri K. D. Amre	National Organic Chemical Industries Ltd, Bombay
Shri M. C. Patwardhan (*Alternate*)	
Shri C. N. Chandrasekharan	Directorate General Ordnance Factories (Ministry of Defence), Calcutta
Shri Charanjit Lal	Controller of Explosives, Nagpur
Shri B. R. Dave (*Alternate*)	
Dr D. Choudhuri	Indian Chemical Manufacturers' Association, Calcutta
Shri D. K. Sirkar (*Alternate*)	
Shri A. M. Dand	Indian Petrochemicals Corporation Ltd, Vadodara
Shri D. L. Vyas (*Alternate*)	
Deputy Director (Chem), Research, Designs and Standards Organization, Lucknow	Railway Board (Ministry of Railways)
Dr S. S. Gothoskar	Directorate General of Health Services, New Delhi
Shri R. Balasubramanyan (*Alternate*)	
Shri K. C. Gupta	National Safety Council, Bombay
Shri N. Raghavan (*Alternate*)	
Shri C. Hingarh	Century Rayon, Kalyan
Shri J. J. Adhia (*Alternate*)	
Dr V. R. B. Mathur	Directorate General of Technical Development, New Delhi
Shri O. P. Nangia	Hindustan Organic Chemicals Ltd, Rasayani
Shri A. G. Sheshan (*Alternate*)	
Dr K. Narayanan Rao	Bhabha Atomic Research Centre, Bombay
Dr D. J. Parikh	National Institute of Occupational Health, Ahmadabad

(*Continued on page* 2)

© *Copyright* 1981
INDIAN STANDARDS INSTITUTION
This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
Dr S. B. Ray	Ministry of Defence (DGI), Pune
Shri T. N. Rewal	Ministry of Defence (DGI), Kanpur
Shri P. Dutta (*Alternate*)	
Shri N. K. Samanta	Indian Explosives Ltd, Calcutta
Shri A. Sinha (*Alternate*)	
Dr P. N. Viswanathan	Industrial Toxicology Research Centre (CSIR), Lucknow
Dr B. N. Gupta (*Alternate*)	
Dr Hari Bhagwan, Director (Chem) (*Secretary*)	Director General, ISI (*Ex-officio Member*)

Industrial Chemical Hazards Subcommittee, CDC 18 : 4

Convener	
Shri S. C. Kale	Directorate General, Factory Advice Service & Labour Institutes (Ministry of Labour), Bombay
Members	
Dr V. P. Gupta (*Alternate* to Shri S. C. Kale)	
Shri G. R. Balasubramanian	Bhabha Atomic Research Centre, Bombay
Shri Charanjit Lal	Controller of Explosives, Nagpur
Shri B. R. Dave (*Alternate*)	
Dr S. R. Chaudhury	All India Institute of Hygiene & Public Health, Calcutta
Dr D. Choudhuri	Union Carbide of India Ltd, Calcutta
Deputy Director (Chem), Research, Designs and Standards Organization, Lucknow	Railway Board (Ministry of Railways)
Shri V. N. Godbole	Albright Morarji and Pandit Ltd, Ambarnath
Shri K. R. Prabhu (*Alternate*)	
Shri K. C. Gupta	National Safety Council, Bombay
Shri N. Raghavan (*Alternate*)	
Shri P. V. Kango	Indian Chemical Manufacturers' Association, Calcutta
Dr R. V. Subramaniam (*Alternate*)	
Dr C. R. Krishnamurti	Industrial Toxicology Research Centre (CSIR), Lucknow
Dr P. N. Viswanathan (*Alternate*)	
Dr S. L. Mehta	Century Rayon, Kalyan
Shri R. K. Shukla (*Alternate*)	
Dr O. P. Mittal	Ciba-Giegy of India Ltd, Bombay
Dr C. S. B. Nair	The Fertilizer and Chemicals Travancore Ltd, Udyogmandal
Dr D. J. Parikh	National Institute of Occupational Health, Ahmadabad
Shri J. D. Parikh	The Atul Products Ltd, Atul
Shri M. V. Desai (*Alternate*)	

(*Continued on page* 10)

Indian Standard

CODE OF SAFETY FOR ALUMINIUM ALKYLS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 February 1981, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

0.2 Aluminium alkyls are a group of organo-aluminium compounds which are being used in different chemical reactions like alkylation, polymerization, organic syntheses and also as pyrophoric ignitors and reducing agents.

0.2.1 Some of the aluminium alkyls also contain chlorine in their structures, and they show high chemical reactivity when exposed to air, water or other chemicals. The chemicals and their reaction products are toxic and thus pose a hazard to safety and health. Since these chemicals are finding a wide range of applications in industries, this code has been compiled. It would be helpful in taking the necessary protective, preventive and precautionary measures against these hazards.

0.3 In the preparation of this code, information has been collected from the following important books, publications, articles and other sources:

a) KIRK-OTHMER. Encyclopedia of chemical technology. 1979. Ed 5. John Wiley, New York.

b) SAX (N Irving). Dangerous properties of industrial materials. 1979. Ed 5. Van Nostrand Reinhold Co, New York.

c) KNAP (J E) *et al.* Safe handling of alkyl aluminium compound. *Ind Eng Chem*, 49, 1957, 874-878.

d) MIRVISS (S B) *et al.* Pyrophoric organometallics, *Ind Eng Chem.*, 53, 1961; 53A-56A.

e) HECK (W B) *et al.* Aluminium alkyls—Safe handling. *Ind Eng Chem*, 54, 1962; 35-38.

1. SCOPE

1.1 This standard describes properties of aluminium alkyls; the nature of hazards associated with them; essential information and direction on storage, handling, packing, labelling; disposal of waste; cleaning and repair of tanks and equipment; selection and training; personal protective equipment and first-aid.

1.1.1 This code does not, however, deal with specifications for design of buildings, chemical engineering plants, storage vessels, equipment for waste disposal and operations control.

2. TERMINOLOGY

2.1 For the purpose of this code the definitions of the terms given in IS : 4155-1966* and IS : 4167-1981† shall apply.

3. PROPERTIES OF ALUMINIUM ALKYLS

3.1 Important physical properties of aluminium alkyls are given in Appendix A.

3.2 Reactivity of Aluminium Alkyls

3.2.1 On exposure to air, aluminium alkyls are spontaneously combustible and catch fire and burn at once. The white dense fumes contain aluminium oxide and are irritating and have penetrating odour.

3.2.2 Aluminium alkyls on contact with water react with explosive violence. The gaseous hydrocarbons so liberated are flammable. Reactions between the alkyls and ethers, alcohols, acids, aldehydes, ketones, esters, amines, halogen derivatives, mercaptans proceed with explosive violence. When an alkyl also contains chlorine, decomposition products contain hydrochloric acid fumes which are corrosive and irritating.

3.2.3 The violent reactivity is reduced if aluminium alkyls are diluted with petroleum hydrocarbons such as petroleum naphtha and a 15 or 20 percent solution does not show spontaneous combustion and reacts with water or air at a moderate rate. Such solutions are therefore relatively safe to handle.

NOTE — For example, aluminium sesquichloride (25 percent solution in naphtha) would fume on exposure to air but may not ignite or spontaneously burn.

---

*Glossary of terms relating to chemical and radiation hazards and hazardous chemicals.

†Glossary of terms relating to air pollution (*first revision*).

4. HAZARDS

4.1 Direct contact with any aluminium alkyl would cause severe burns and blisters on the skin. They have to be treated as tissue burns which heal slowly and leave scars.

4.1.1 Even a dilute solution would cause burns and blisters on the skin upon direct contact.

4.2 Even a trace amount entering the eyes would cause painful irritation.

4.3 It is unlikely that pure aluminium alkyl as such would be inhaled. Its reaction with water or air is instantaneous and the respiratory irritation and other internal health effects would be due to the decomposition products such as aluminium oxide fumes, hydrochloric acid fumes, etc. The effects are acute and cause severe irritation of the respiratory and other systems.

4.4 Threshold Limit Value — The American Conference of Governmental Industrial Hygienists, USA, has recommended a TLV of 2 mg/m^3 for an 8-hour work day and 40-hour week. This value is mentioned here only to serve as a guide line for providing the control measures.

5. STORAGE, HANDLING AND TRANSPORTATION

5.1 Storage

5.1.1 The store area should be specially designed in view of the hazards associated with these chemicals. The area should be well ventilated and provided with necessary inert gas lines for transfer of the chemical and the fire fighting arrangements.

5.1.2 Containers for aluminium alkyls should be properly tested and be of the approved type. They should be filled under nitrogen pressure. All precautions necessary when using nitrogen pressure for transfer of chemicals should be taken.

Each container should be properly closed, sealed and plainly labelled indicating the name of the chemical, manufacturer's and customer's names and addresses, hazard warning and identification symbols, hazard information, and emergency instructions.

5.2 Handling

5.2.1 Aluminium alkyls should be handled in a totally enclosed system in view of their reactivity. Contact with air and water should be avoided by properly designing the equipment and plants.

5.2.2 *Spillage* — Wherever there is a possibility of spillage of alkyls, it should be collected in tubs or troughs containing an inert absorbent, such as, dry sand and cockwool. Where possible, a small layer of paraffin oil should be kept to serve as a diluent for the spilled material and reduce the hazard. The collected material should be disposed of taking due care.

5.2.3 *Waste Disposal* — Whether in the laboratory or in the plant, in no case aluminium alkyls should be allowed to flow into the general drainage system. All precautionary measures shall be taken in this regard. Otherwise violent explosions and fires may result causing extensive damage.

5.2.3.1 Waste amounts of aluminium alkyls shall not be disposed of as such. They shall be rendered less hazardous by dilution with suitable media such as mineral oil, naphtha or paraffin to avoid spontaneous combution. The diluted material should be burnt under careful supervision by trained persons who should be well protected against exposure to the decomposition products. Disposal area should be isolated and the material should be carefully transported No direct contact with water, acids, alcohols should be allowed to take place.

6. LABELLING

6.1 Aluminium alkyls containers shall bear appropriate pictorial warning labels based on IS : 1260 (Part I)-1973* to indicate the hazards involved.

6.2 The following information should be utilized or incorporated in the labels along with other information in an appropriate manner:

a) Aluminium alkyl (give the chemical's name and formula);
b) Violently reacts with water, air and organic materials;
c) Decomposition products extremely irritating;
d) Collect spillage in tubs containing dry sand and paraffin oil;
e) Do not use water or foam for fighting of fires;
f) Use dry sand to fight fires;
g) Use proper personal protective equipment;
h) In case of contact, wipe immediately with paraffin oil followed by washing with plenty of running water; and
j) Get medical attention.

7. GENERAL SAFETY MEASURES

7.1 The plant areas should be properly designed and non-combustible material should be used for construction.

---

*Pictorial markings for handling and labelling of goods: Part I Dangerous goods (*first revision*).

7.2 Presence of steam or water is undesirable. Hence water or steam lines which have to inevitably pass through the area should have no flanges, valves or taps which may act as sources of leakage, leading to accidents and disasters.

7.3 Dry, oxygen-free nitrogen or argon supply in pipes should be available for the transfer of the material and filling of containers.

7.4 Precautions against suction of air into the system or pressure built up should be taken.

7.5 The flooring should have proper finish and slope directed to a dry trench and sump for collection of spillage away from the equipment. Facilities for emptying and cleaning of pipe line with inert solvents should be provided.

7.6 Even where alkyls are handled in small quantities, as in the laboratory, reactions should be carried under a ventilated hood and precautions against contact with water in the drain and for fighting fires should be taken.

7.7 Sufficient help should be available for fire fighting.

7.8 Personnel should use proper eye and other personal protection equipment.

8. FIRE FIGHTING

8.1 Aluminium alkyls ignite spontaneously in air and violently react with water. Hence any fire extinguishing agent containing, for example, water, soda, acid, foam should not be used.

8.2 Where possible, bulk material should be allowed to burn itself out while efforts should be directed to prevent the spread of fire.

8.3 Even dry chemical agents, such as carbon-dioxide and halogenated compounds are not effective as extinguishing agents. Hence only dry sand type agents should be used. Diatomaceous earths, perlite may be used as they act as absorbents for the alkyls. Vermiculite is also found to be effective as it is inert to alkyls, remains dry and does not absorb moisture.

NOTE — Vermiculite weighs approximately 112·14 kg/m^3. If applied as a 5-10 cm blanket on bulk alkyls, prevents contact with air.

8.3.1 In case of fire, dry powder extinguisher should be used to extinguish the fire in the ratio of 2 of powder to 1 of alkyl. Asbestos or fibre glass blankets should be readily available in case of splashes on clothing.

8.4 Sodium bicarbonate and phosphate based dry powerd type extinguishing agents are also effective when applied as a thick layer.

8.5 Even when the fire has been put out, it is advisable to keep the extinguished material under observation as secondary reactions may be caused due to decomposition. Bulk sodium bicarbonate should be available for use in such situations.

9. PERSONAL PROTECTIVE EQUIPMENT

9.1 Aluminium alkyls upon combustion/decomposition give rise to dense white smoke of aluminium oxide. Alkyls containing chlorine also liberate hydrogen chloride which is corrosive and irritating. Personal protective equipment consisting fire proof overalls, gloves, footwear should be available for use of the persons according to the nature of work and possibility of exposure. In view of severe reactivity, gas-tight eye protection and face shields should be used by every exposed person.

9.2 Full respiratory protection should be available for use of those engaged in waste disposal, cleaning operations and fire fighting.

9.3 All personal protective equipment should be peroidically inspected to ensure that they afford protection in actual use.

10. TRAINING OF PERSONNEL

10.1 All persons working in the plant or in the laboratories should receive proper training regarding the nature of hazards and their severity, preventive control measures, use of personal protective equipment, fire fighting measures and procedures, emergency procedures and actions to be taken. Periodic refresher training should be given to them according to the requirements.

11. FIRST AID

11.1 Clothing or other protective equipment splashed with alkyls should be promptly removed. The emergency shower should be used in case of skin contact till all suspect contamination has been washed away. Water would also be helpful in removal of heat.

11.2 Contact with alkyls as such causes severe burns. The dilute solutions also cause burns due to reaction with skin moisture. The injured person should be taken to a physician as soon as possible.

APPENDIX A

(*Clause* 3.1)

PROPERTIES OF IMPORTANT ALUMINIUM ALKYLS

Sl No.	Properties	Triethyl Aluminimu (TEA)	Tri N-Butyl Aluminium (TNBA)	Tri-isobutyl Aluminium (TIBA)	Isoprenyl* Aluminium (IPRA)	Di-isobutyl Aluminium Hydride (DIBAH)	Diethyl Aluminium Chloride (DEAC)	Ethyl-Aluminium Sesquichloride (EASC-D)	Ethyl Aluminium Dichloride (EADC)
i)	Chemical formula	$(C_2H_5)_3 Al$	$(n\text{-}C_4H_9)_3 Al$	$(i\text{-}C_4H_9)_3 Al$	$(i\text{-}C_5H_{10}) + (i\text{-}C_4H_9)y Al$	$(i\text{-}C_4H_9)_2 Al H$	$(C_2H_2)_2 Al Cl$	$(C_3H_5)_3 Al_2Cl_3$	$C_2H_5Al Cl_2$
ii)	Description	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid
iii)	Molecular weight	114·17	198·33	198·33	—	142·22	120 56	247·51	126·95
iv)	Boiling point, °C, at 1 torr	62	98	42	—	114	95	90	80
v)	Freezing point, °C	−47	−54	6	—	under −74	−70	−20	22
vi)	Specific gravity at 20°C	0·84	0·83	0·79	0·88-0·99	0·80	0·97	1·09	1·23 (at 25°C)
vii)	Viscosity cP at 20°C	3·0	12·9	2·4	Not above 58-cSt	12·1	1·8	2·3	3·2 (at 23°C)

*Data pertains to a 80 percent IPRA solution with a $C_5 : C_4$ ratio of 2·0 to 3·0.

(*Continued from page* 2)

Members	*Representing*
Shri A. N. Rao	Directorate General of Technical Development, New Delhi
Shri V. V. M. Rao	Hindustan Petroleum Corporation, Bombay
Shri D. V. A. Raju (*Alternate*)	
Shri Deepak R. Shah	Excel Industries Ltd, Bombay
Shri S. S. Kaimal (*Alternate*)	
Shri K. K. Subramanian	National Organic Chemical Industries Ltd, Bombay
Shri M. C. Patwardhan (*Alternate*)	
Shri S. A. Trivedi	Navin Fluorine Industries, Bombay
Shri J. N. Parekh (*Alternate*)	
Shri H. K. Venkataramiah	Hindustan Organic Chemicals Ltd, Rasayani
Shri A. G. Sheshan (*Alternate*)	